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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the device which controls vibration of a steel plate and shape in the hot-dipping line of a steel plate, the surface treatment line of a color steel sheet, the rolling line of a steel plate, etc.

[0002]

[Description of the Prior Art]In an iron-manufacture process line, it is common to process hot dipping, annealing, etc. and to produce commercially, making a steel plate convey. When making a steel plate convey, making shape of a steel plate into the convenient shape for processing, and adding vibration if needed is performed.

[0003]Vibration of the steel plate in the wiping nozzle position of a molten zinc plating line and shape controlling occur as one of them.

[0004]The example (what is shown in JP,8-197139,A) is explained to drawing 6 and drawing 7. in drawing 6 and drawing 7 -- 1 -- as for a wiping nozzle and 5, the position detection sensor of a steel plate and 3 are [ a control circuit and 7 ] drive circuits a subtractor and 6 an electromagnet and 4 a steel plate and 2.

[0005]The steel plate in which the surface adhered to molten zinc moves to the upper part in drawing 6, and reaches the position of the wiping nozzle 4. From the wiping nozzle 4, the gas is sprayed toward the steel plate 1 and plating thickness is controlled with the gaseous amount of spraying. Therefore, the steel plate 1 vibrates, or if the shape of the steel plate 1 is no longer a flat, the distance of the wiping nozzle 4 and the steel plate 1 will be changed, the gaseous amount of spraying changes, and it becomes a cause of change of plating thickness.

[0006]Therefore, it is necessary to suppress vibration of the steel plate 1 in the position of the wiping nozzle 4, and to make shape of the steel plate in this position as flat as possible. For this purpose, the position detection sensor 2 detects the position of the steel plate 1, and the

deviation is computed with the subtractor 5 as compared with a desired value. And the control circuit 6 drives the electromagnet 3 via the drive circuit 7 so that this deviation may be set to 0. The steel plate 1 is attracted by the electromagnet 3. Therefore, according to this control system, vibration of the steel plate 1 in the installed position of the position detection sensor 2 can be suppressed, and shape can be made into a flat.

[0007]

[Problem(s) to be Solved by the Invention]However, the position which must suppress vibration of the steel plate 1 and must make shape flat, Even if vibration of the steel plate 1 is suppressed in the near position of the position detection sensor 2 and shape becomes flat therefore it is an about four-wiping nozzle position and is not near the installed position of the position detection sensor 2, That such a state is realized in wiping nozzle 4 position has the problem that it is not guaranteed that it is not guaranteed, therefore plating thickness becomes uniform, either.

[0008]In JP,8-197139,A, although a target position correction circuit is provided and it is performing changing the target of the shape of the steel plate 1 in position detection sensor 2 installed position as a measure to this, it is necessary to define a correction amount beforehand. However, it is difficult to predict a correction amount beforehand, and it is impossible to follow in footsteps of change of the board width or an operating condition. Therefore, sufficient result cannot be raised with this method.

[0009]This invention was made in order to solve such a problem, and in the process line of a steel plate, an object of this invention is to provide the device which controls vibration of a steel plate and shape, especially the device which controls vibration of the steel plate in a wiping nozzle position, and shape in a molten zinc plating line.

[0010]

[Means for Solving the Problem]Said technical problem arranges two or more pairs of electromagnets to both sides of a steel plate it runs in a steel plate width direction, In and a position which he is [ position ] vibration and the shape controlling device of a steel plate which has vibration and the shape controlling means which controls vibration and shape of a steel plate by approaching an electromagnet, forming a displacement sensor of a steel plate position, and adjusting a suction force of an electromagnet based on a signal from said displacement sensor, and wants to control vibration of a steel plate and shape. It is solved by vibration and a shape controlling device of a steel plate controlling vibration and shape of a steel plate (claim 1) by forming vibration and a shape sensor which detects vibration and shape of a steel plate apart from said displacement sensor, and feeding back a signal of said shape sensor to said shape controlling means.

[0011]Although an operation of vibration and a shape controlling means is the same as what was explained by conventional technology, In this invention, a shape sensor which detects

shape of a steel plate is formed in a position which wants to control vibration of a steel plate and shape apart from said displacement sensor, and control is performed by feeding back a signal of said shape sensor to said shape controlling means. Therefore, eventually, vibration and shape of a position of liking to control vibration of a steel plate and shape will be controlled.

[0012]In this specification, "vibration and shape" mean both vibration, and both [ one side or ], necessity is accepted, and both vibration, and both [ one side or ] are detected and controlled.

[0013]Especially this method is effective in vibration and shape controlling of a steel plate in a wiping nozzle position in a molten zinc plating line. Although vibration and a shape sensor cannot usually be formed in a position of a wiping nozzle, Since it can attach between wiping nozzles if vibration and a shape sensor are the optical things which have a floodlight in the one plate width direction end side of a steel plate, and have an electric eye in the other end side (claim 2), it can be used effectively.

[0014]Vibration and two or more shape sensors are especially installed as a laser type line sensor, An optical axis direction of the inner 1 set laser type line sensor is abbreviated-coincided with a pass line of a steel plate, if an optical axis direction of other laser type line sensors is made to incline to a pass line of a steel plate and it attaches, it can grasp shape of a steel plate correctly and exact control of it will be attained.

[0015]

[Embodiment of the Invention]Hereafter, the example of an embodiment of the invention is explained using figures. Drawing 1 is a block diagram showing the example of an embodiment of the invention. in drawing 1 -- 1 -- the steel plate after control, and 1' -- the steel plate before control, and 2 -- the position detection sensor of a steel plate, and 3 -- as for a drive circuit and 8, a wiping nozzle and 6 are [ a metal skin and 10 ] sink rolls vibration and a shape detection sensor (laser type line sensor), and 9 a control circuit and 7 an electromagnet and 4. The position detection sensor 2 of a steel plate, the electromagnet 3, the control circuit 6, and the drive circuit 7 correspond to vibration and a shape controlling means.

[0016]That is, the position detection sensor 2 detects the position of the steel plate 1, and the control circuit 6 drives the electromagnet 3 via the drive circuit 7 so that the deviation of this detection value and desired value may be set to 0. The steel plate 1 is attracted by the electromagnet 3. Therefore, vibration of the steel plate 1 in the installed position of the position detection sensor 2 can be suppressed, and shape can be controlled by this control system. This operation is the same as conventional technology.

[0017]In this invention, in addition to this composition, vibration and the shape detection sensor 8 were formed, and vibration and shape of the steel plate 1 in wiping nozzle 4 position are detected.

[0018]In this embodiment, vibration and the shape detection sensor 8 are laser type line

sensors, and detects the existence of the obstacle in the passage of light by scanning laser to constant width.

[0019]The outside schematic illustration is shown in drawing 2. Drawing 2 is the figure which looked at the electromagnet 3, and vibration and a shape detection sensor 8 from the upper part. In the following figures, the same numerals are given to the element indicated to the figure of all the appearance, and the explanation is omitted. In drawing 2, 8a is a floodlight of a laser type line sensor, and 8b is the electric eye. Each of aluminum, Bi, Cl, Ar(s), Br(s), and Cr (s) is the electromagnets 3. The installed position of the electromagnet 3, and vibration and a shape detection sensor 8 differs in height.

[0020]A part is interrupted by the steel plate 1 and a part of scanning light which came out of the floodlight 8a reaches the electric eye 2. therefore -- the steel plate 1 exists in which position with the output of the electric eye 2 -- an outline -- it can know shape [ how ] is carried out.

[0021]When there is much light intercepted with the steel plate 1, C type curvature as shown in drawing 2 usually called C curvature has occurred. In such a case, the control circuit 6 can cancel C curvature by applying the power of an opposite direction to the electromagnet located at the center, and the electromagnet located in both ends mutually via the drive circuit 7.

[0022]For example, when there is a tendency for C curvature to be controlled by making the suction force of the electromagnet 3 into  $Bi < Br$ , aluminum  $> Ar$ , and  $Cl > Cr$ , C curvature can be canceled by increasing the difference, leaving the size relation of a suction force as it was. On the contrary, when C curvature is promoted by considering it as  $Bi < Br$ , aluminum  $> Ar$ , and  $Cl > Cr$ , C curvature can be controlled by reversing the size relation of a suction force.

[0023]Instead of controlling the suction force of the electromagnet 3 directly, a cascade regulation may be performed to vibration and a shape controlling means. Namely, if it is in the tendency for C curvature to be canceled when the desired value of the distance between the steel plate 1 which vibration and a shape controlling means are controlling, and an electromagnet is made it is short on the right-hand side at the steel plate 1 center side, and long on the right-hand side at the both ends of the steel plate 1, If it is in the tendency to strengthen the degree, to go and for C curvature to be promoted, it is long on the right-hand side in the desired value of the distance between steel plate 1 electromagnets at the steel plate 1 center side, and C curvature can be canceled by making it short on the right-hand side at the both ends of the steel plate 1.

[0024]This control block diagram is shown in drawing 3. In drawing 3, the same numerals are given to the same element as what is indicated to drawing 1, and explanation is omitted. In drawing 3, vibration and the shape controlling means which explained 5 and 5' with the subtractor and explained 20 by conventional technology, and 30 are the 2nd control circuit.

[0025]Vibration and the shape controlling means 20 detect the position of the steel plate 1 with

the position detection sensor 2, and is computing the deviation with the subtractor 5 as compared with a desired value. And the control circuit 6 drives the electromagnet 3 via the drive circuit 7 so that this deviation may be set to 0.

[0026]The output of vibration and the shape detection sensor 8 is inputted into subtractor 5'. The position of the steel plate in wiping nozzle 4 position is inputted into subtractor 5' as a desired value of control, and a difference with the output of vibration and the shape detection sensor 8 is inputted into the 2nd control circuit 30. The 2nd control circuit 30 opts for and gives the input (desired value) to the subtractor 5 so that this deviation may become zero.

[0027]When the steel plate 1 is vibrating, vibration can be detected by changing the position of the transmitted light which the electric eye 2 receives. In this case, the control circuit 6 gives the power in which this vibration is negated to the electromagnet 3, via the drive circuit 7.

[0028]If two laser type line sensors are used, it can respond to more complicated C curvature. This outline is shown in drawing 4. In drawing 4, 8' is the 2nd laser type line sensor, 8'a is the floodlight and 8'b is the electric eye. The laser type line sensor 8 receives the pass line of the steel plate 1, and parallel, laser type line sensor 8' receives the pass line of the steel plate 1, and it is slightly provided in right and left with inclination. And two line sensors shift height slightly and are attached.

[0029]Although the operation of the laser type line sensor 8 is the same as the above-mentioned operation, laser type line sensor 8' plays the role which detects the direction of C curvature. That is, in the case of C curvature of direction like drawing 4 (a), there are few rates that the light of laser type line sensor 8' is shaded, but when it is C curvature like drawing 4 (b), a great portion of light will be shaded. Therefore, direction of C curvature can be distinguished from the light income of laser type line sensor 8', and the direction which applies power to the electromagnet 3 can be detected directly.

[0030]Like drawing 4 (c), when the steel plate 1 passes aslant, the amount of protection from light of the laser type line sensor 8 is large, and the amount of protection from light of laser type line sensor 8' becomes small. Therefore, it can detect that the steel plate 1 has passed aslant in this direction, and steel plate 1 position can be returned in parallel with a pass line by adjustment of the power applied to the electromagnet 3.

[0031]When the slope direction of the steel plate 1 is contrary to drawing 4 (c), since the amount of protection from light of laser type line sensor 8' becomes large and the light income of the laser type line sensor 8 becomes small, it becomes detectable. If a laser type line sensor is attached for reverse with one more set and laser type line sensor 8' and the information from three sets of sensors is used, the shape of the steel plate 1 and inclination can be grasped more correctly.

[0032]

[Example]This invention was carried out using the device shown in drawing 1. In this example,

C cambered amount detected by vibration and the shape detection sensor 8 is inputted into the control circuit 6 only paying attention to control of shape, The cascade regulation as shows vibration and the shape controlling means which consists of the position detection sensor 2, the electromagnet 3, the control circuit 6, and the drive circuit 7 to drawing 3 made into a minor loop was performed.

[0033]The control result is shown in drawing 5. It is C cambered amount (the amount of protection from light) from which the horizontal axis was detected by time and the vertical axis was detected by vibration and a shape detection sensor (laser type line sensor) in drawing 5. Although C cambered amount is large before control and it is vibrating, C cambered amount became small and after control is understood that it is stable.

[0034]

[Effect of the Invention]As explained above, in this invention, an electromagnet is arranged two or more pairs to both sides of the steel plate it runs in a steel plate width direction, In and the position which he is [ position ] vibration and the shape controlling device of the steel plate which has vibration and the shape controlling means which controls vibration and shape of a steel plate by approaching an electromagnet, forming the displacement sensor of a steel plate position, and adjusting the suction force of an electromagnet based on the signal from said displacement sensor, and wants to control vibration of a steel plate and shape. Vibration and shape of a steel plate are controlled by forming vibration and the shape sensor which detects vibration and shape of a steel plate apart from said displacement sensor, and feeding back the signal of said shape sensor to said shape controlling means.

Therefore, control in the position which wants to control vibration of a steel plate and shape can be ensured.

[0035]In the position of the wiping nozzle in a molten zinc plating line, especially. Usually, since it can attach between wiping nozzles if vibration and a shape sensor are the optical things which have a floodlight in the one plate width direction end side of a steel plate, and have an electric eye in the other end side, although vibration and a shape sensor cannot be formed, By this invention, vibration and the defect of shape of the steel plate in a wiping nozzle position can be prevented effectively.

[0036]Vibration and two or more shape sensors are installed as a laser type line sensor, The optical axis direction of the inner 1 set laser type line sensor is abbreviated-coincided with the pass line of a steel plate, if the optical axis direction of other laser type line sensors is made to incline to the pass line of a steel plate and it attaches, it can grasp the shape of a steel plate correctly and the exact control of it will be attained.

[Translation done.]